Final Bachelor/Master Thesis Proposal on Solving Integral Equations Faster using GPUs

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The Graphical Processing Units (GPUs) Technology Conference to be held in California in March 2014 is showing that GPU computing is becoming increasingly mainstream. The goal of this project is to explore the possibilities that this new platform offers to speed up the numerical resolution of integral equations. These equations appear in modeling the radiative transport of heat, sound and light. The fact that the discretization of these equations typically results in dense linear systems is expected to offer tremendous possibilities in accelerating the current state of the art. These expectations are being confirmed by first results being published in the literature [1]. The reduction of simulation time that GPU computing promises is urgently needed in currently ongoing projects on the numerical modeling of industrial furnaces. In these projects the bottleneck formed by the solution of radiative heat transfer models currently prevents the assessment of more realistic fuel models. Another example of application of this work is the scattering of electromagnetic waves on random collections of particles such as aerosols, atmospheric clouds and gasses.

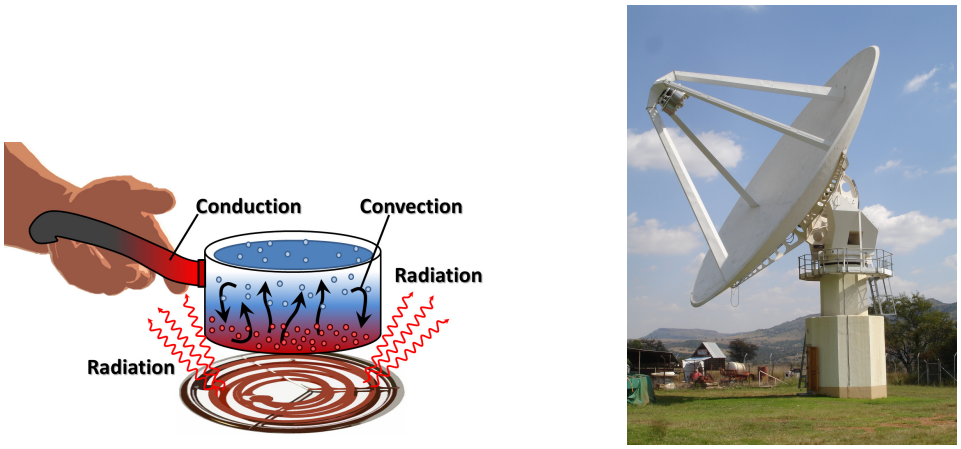

Figure 1: Examples of radiative transfer phenomena.

We foresee the following stages in the project

1. perform literature study on the formulation and the discretization of integral equations in electromagnetic scattering and radiative heat transfer;
2. perform literature study on GPU computing;
3. implement of GPU based solver for integral equations;
4. perform numerical experiments;
5. prepare final report.

References

[1] Shaojing Li, Ruinan Chang, A. Boag, and V. Lomakin. Fast electromagnetic integral-equation solvers on graphics processing units. *Antennas and Propagation Magazine, IEEE*, 54(5):71–87, 2012.